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COMMENT AND NEWS

The results of the Ann Arbor Conference on scientific management justified the efforts of the Governing Board to make it the logical successor of the 1911 Tuck School Conference. The arrangement of the program gave opportunity for a most comprehensive discussion of the principles of scientific management, both in general and with respect to their application to different types of industry, and, what is more significant, the program was carried out essentially as arranged. To those who participated in the program; to the Department of Engineering of the University of Michigan; and to Professor Bursley, chairman of the local committee on arrangements, grateful acknowledgments are rendered.

The one hundred eighty delegates registered at the conference represented one hundred twenty-five firms, sixty cities, twenty-five states and one foreign country. In addition, there were many students and local residents of Ann Arbor present at the various sessions but not registered.

Criticisms and suggestions concerning the plan and conduct of the conference have been requested from a large number of those who were in attendance. Replies have brought an abundance of complimentary and gratifying opinions. Apparently nearly everyone received some measure of the inspiration described in the words of one of the correspondents: "I decided that, personally, I would take a new interest in the scientific management movement, possibly give it my main attention."

The criticisms and suggestions may be summed up as follows: the round table discussions should have been stenographically reported and provision made for their publication; the round-table discussions should have been distributed through more sessions so that members could have attended more of them; the program should have been more a description of mechanism and methods; the program should have provided for discussion of the labor problems in scientific management.

The Governing Board did not dare to face the financial risks involved in reporting and publishing the discussions. It knew that it had cost the Tuck School $500 to report and $1300 to publish the Conference of 1911, an expense which did not include payment for some four or five months of laborious work editing the copy which came from the stenographers. That the round-table discussions should have been distributed through more sessions, thereby enabling members to attend more of them, is acknowledged. It is now realized that round-table discussions constitute a most important element in such a conference.

The suggestion that the addresses and discussions should have been more detailed and descriptive presents a large problem. The Ann Arbor program was planned to accommodate a wide range of auditors: those who know nothing of the principles of scientific management; those who understand the principles but know nothing of the results of their application; those who think they understand the principles but do not, and so on. An exposition of the fundamental principles of scientific management was absolutely essential to the plan. The question arises whether an exclusively detailed and descriptive program would have been in the nature of the case possible. Is there not something in the nature of scientific management which limits conferences to discussions of principles, and which requires that detail methods be observed by visits to plants?

The concluding session of the conference seemed to demonstrate that inquiry concerning the relations of scientific management and labor must be given a place in every program; otherwise it will choose its place for itself. That session gave opportunity for frank expressions of opinion concerning scientific management and concerning the conference itself, by those who had been in attendance. It resolved itself practically into a discussion of the obligations of the Taylor Society to the public, with respect to providing for the investigation of and public discussions of the labor aspects of scientific management. Of course those who criticised the conference because lacking in opportunity for discussion of the labor problem, were not aware of the opportunities which had been afforded by other meetings of the Society, nor did they appreciate exactly the purposes of the Ann Arbor Conference. However, it is significant to note the direction taken by discussions at the final session, and also to note that the session "was frequently referred to as the most instructive session which had been held."

SCIENTIFIC METHODS OF MANAGEMENT APPLIED TO VARIOUS TYPES OF INDUSTRY[1]

By Sanford E. Thompson[2]

At a recent congress on industrial management, the subject of one of the papers was the limitations of scientific management. The author, a prominent man in his own line, public service utilities, discussed the subject, laying special emphasis on the *absurdity* of introducing scientific management into a machine shop handling miscellaneous work. Unfortunately for his argument, the man next on the program was Mr. Wilfred Lewis, Vice-President of the Tabor Manufacturing Company. He described the *success* of scientific management in his machine shop which handled miscellaneous kinds of work.

The breadth of the movement is shown by the very diversity of the industries which are adopting scientific methods to a greater or less degree—industries including machine shops, textile mills, paper mills, pulp mills, printing shops, box factories, clothing shops, automobile plants, shops making novelties, construction plants, clerical departments, and other processes almost too numerous to classify. The very fact that such varied industries can adopt principles fundamentally alike illustrates two things:

(1) The universal scope of the science of management and

(2) The diversity, yet identity in principle, of the system required for control.

Fundamental Principles of Scientific Management

An explanation of this unity, yet diversity, lies in the fact that management is not a system—it is not merely an art—but it is a science and a science based not on mere physical laws but consisting of a philosophy with the four great underlying principles brought out by the late Dr. Frederick W. Taylor.*

(1) The development of a science for each element of a man's work.

(2) The scientific selection of the workman.

(3) His scientific education and development.

(4) Intimate, friendly coöperation between management and men.

The science of management determines after thorough study and thorough investigation the best way of performing each individual operation; the proper sequence of operations; the tools and implements which give the best results; the proper material to use under different conditions; the quantities of materials required for a given quantity of product; the best method of distribution; the quality that must be obtained; the proper time to perform each operation; the type of workman suited for the job; the best method of instructing the workman; the plan of organization best fitted to establish and maintain the benefits derived from the mutual endeavors of the men and the management.

Take what industry you may choose, select any process in that industry, and you will find an opportunity for applying these fundamental principles; applying them in the standardizing of materials; applying them in the standardization of the processes; applying them in the distribution of the materials and the work; applying them in the determination of standards of quality; applying them in the organization. You will find, not merely opportunity, you will find on close examination a crying need for these things, and you will wonder how under the sun conditions have been going on for decade after decade following the rule-of-thumb methods with the idea that because it always has been done in a certain way it must be right. I tell you, gentlemen, it is almost a dead sure fact if a thing has always been done in a certain way, it is radically wrong.

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[1] An address before the Taylor Society at the Ann Arbor Conference on Scientific Management, Ann Arbor, Mich., May 11, 1916.

[2] Member American Institute of Consulting Engineers, Boston, Mass.

* The Principles of Scientific Management, by Frederick W. Taylor, p. 36, Harper & Brothers, 1911.

It is then because of the fundamental nature of this science, because indeed of the fact that management is a science, that we have this search, this continued striving, for the attainment of the means for applying system to production.

The fundamental principles of the science of management frequently are confused with the machinery necessary for carrying the principles into effect. It is the machinery—the system—that is criticised. If we only could let scientific management blow down from the sky; if we could breathe into the souls of the management and men, the life-giving properties; if we could install, to automatically operate it, some system of air current or electrical control or, better still, some system of hydraulic pressure, there would be no question about its universal adoption.

But we must bear in mind one thing—to accomplish great things great efforts are necessary.

If scientific management would come in with the summer breezes, it would have been adopted universally long ago.

It is failure to appreciate the necessity for thoroughness,—it is, in fact, many times the failure to adopt what are really scientific methods that sometimes has put scientific management into disrepute. Not long ago I visited a paper mill where the installation of certain new methods had been made in a superficial way. I examined the records and noticed that the pay per hour of the same men varied anywhere from twenty-five to forty cents. I asked the reason for this,—whether there was such constant variation in the accomplishment of this man. "Oh, no," they said, "the character of the stock varied. This caused the difference." Now the trouble here was a very fundamental one—one that you run up against in case after case. The rates had been adopted, the department had been in a measure systematised without the adoption of standards. This is *not* scientific management.

In this case, so-called standards had been set on what had been done instead of on what can and should be done; time studies had been made on the process as practiced and not on the process developed through careful, analytical treatment designed to correct defects in machinery and workmanship.

In the scientific method we have the detailed analysis of each individual process; the thorough investigation of methods; the study of times required to produce the various units of work. As a result of this, we establish standards and it is these standards that enable us to accomplish the various results in elimination of waste, improvement in quality, and increase in output.

Now just as soon as we begin to establish accurate, refined standards,—standards of materials and standards of methods, it is evident that more complicated mechanism is necessary to maintain and control these standards.

We frequently hear a manufacturer say that he wants standard methods,—he wants exact piece rates but he doesn't want a complicated system. Now the trouble is, as I have already indicated, that you can't produce uniform results without well defined methods of management. You can't turn out hundreds of screws a minute on a common lathe,—you can't build 2000 automobiles a day in an ordinary machine shop.

Necessity for Mechanism

To illustrate how this necessity for mechanism presents itself, let us take first a simple manufacturing operation, the cutting of paper, and assume for the moment that the object is the setting of exact piece rates or tasks. To further illustrate this point, let us take after this another type of operation, the making of paper, where the best results can be obtained through uniformity of product. Although the character of these two operations is absolutely different, I want to show how the principles are fundamentally alike, and how both require a mechanism similar in principle but different in detail to carry out the science.

The cutting of paper as required in a printing establishment or in the finishing department of a paper mill seemingly is a very simple operation. The machine consists essentially of a table with a slot through which a long knife passes up and down at the will of the operative. The operation consists of taking, in several lifts, the sheets of paper from a truck, placing this on the cutting table until a thickness of about five inches is reached, cutting, turning the paper if more than one cut is needed, and placing the paper in a different number of lifts back on to another truck.

Very simple it is—placing the paper, cutting, and removing. But what do we find when we begin to make studies on the operation for the purpose of laying out, not a piece rate fixed by guess but a definite task adapted to the capacity of the machine and the operative?

We find at once when considering simply the very first operation of lifting on to the machine that the time is affected by the number of sheets taken to a lift. Study shows that the lift which a man can take is dependent upon the thickness of the paper, the size of the paper, the coating of the paper, and the way it is handled.

Before definite times can be fixed even for so simple an operation as cutting paper, a scientific investigation combined with the time study is necessary to allow for each one of these variables, and to find just how the sheets should be handled under all possible conditions. We find that to keep the machine running to the best advantage; to cut as one job sheets of the same size so as to avoid frequent setting of the machine; to arrange the count so as to know the amount run through; a definite scheme of planning and routing of the paper and moving it to and from the machine is absolutely necessary.

In connection with the scientific study and with the arrangement of the routing, but especially for the purpose of determining how much of each grade, size, and weight, should be handled in a given time, study of standard unit times for handling, cutting, turning, etc., must be made.

But having established the time for the job, having routed the materials in proper fashion, the work cannot be put through on time and of the required quality unless the operatives are instructed how much of each grade and size of paper to take at a lift, the thickness that can be cut in each case, the quickest way to manipulate the machines, and so on.

Furthermore, having given definite instructions to the worker, having laid out a task for him to do, which may be two or three times the volume of work previously done by day or by the piece—not because of "speeding up" but because of changes in methods—it is necessary to give him a reward based on accomplishment in the given time and according to the specified instructions.

You will see, and I want to bring out the fact, that this simple operation of paper cutting brings into play the mechanism of standardization, planning, routing, time study, training, and reward. Furthermore, supervision of these things requires, as you readily see, special oversight—not of the general, haphazard nature that a superintendent or foreman or gang boss is accustomed to give—but functional supervision in each line. In other words, functional organization comes into existence almost in natural course.

In the making of paper, and I shall consider simply that part of the process up to the end of the paper machine, the question is not one of task setting primarily, but it involves instead a study of material,—of the raw materials which go into the paper, the variations in the rags and in the wood pulp and in the sulphite, the variations in moisture in each, the control of the water in the beating engine, and the control of the beating engine itself by the beater man. The process is absolutely different from the paper cutting, and yet the method of going about this standardization must be essentially the same as in standardizing the paper for cutting. In the paper cutting, we found as soon as we got to work that it was necessary to study the character of the paper and to standardize the different kinds, and to determine just how much should be applied to the machine and how the machine should be operated. In paper making one must study the nature of the raw materials, classifying and standardizing them. One must plan out the method of getting them to the beating engine, and define the operation of the engine. In other words, standard materials and standard methods must be fixed. Routing is necessary to get the right furnish to the engine at the right time, and to fix the time of beating, just as it is necessary in the paper cutting to get the paper to the undercut machine. Instructions are necessary to show the man just how to operate the beating engine, as they are necessary to show the man how to handle the paper and the machine in cutting. Although the details are different, these two processes require the fundamental treatment of analysis, planning and instruction to the worker.

In many cases it is necessary to go into the operations in great detail and it is economical to do this. In fact, as I have emphasized, one of the distinctive differences between the old and the new methods lies in exact standardization and control.

Necessity for Detail Analysis

The determination of standard methods is at the basis of scientific management, and it is the lack of appreciation of this fact, and along with it the lack of appreciation of unit analysis, that causes the failure,—

1st. To grasp the problem,
2nd. To execute.

I have referred to the simple process of paper cutting. Let us consider the same character of work and a similar machine but a class of operation, which because of the character of the product, is extremely complicated. I have in mind a group of machines in a certain factory where the paper cut may vary in size of sheets from 40″ x 60″ to 20″ x 30″. The cutting may vary from simple edge trimming, as in the other illustration, of sheets we will say 30″ x 50″ in size, down to cutting of these sheets, or smaller ones into pieces as small as one in. square. Frequently in this cutting "hair line" work is required. In other cases, the rough cut is all that is necessary. These particular machines, in the plant I have in mind, had been on piece work for years. One man, very skillful in his mental agility, set the piece rates. He did it, however, entirely as a matter of judgment, and it was physically impossible for him to estimate the different jobs exactly. He would "go into a trance" as one manufacturer told me, and come out with the right rate. When the times were analyzed, it was found that some of the rates might be 50 per cent too high, while others might be 50 per cent too low. Notwithstanding this variation, however, men earned uniformly $25.00 per week. How they managed to figure it out, how they managed to balance up the time on the different jobs of such infinite variety, so that at the end of the week, notwithstanding variations in the rate setting, they received a uniform wage, nobody knew.

To put this work on a scientific basis, very minute time studies were necessary. Each part of the operation, such as lifting, jogging, running gage, trimming, etc., had to be studied in detail and standard methods fixed for each little division of the work, and standard unit times, some of them averaging not more than three or four hundredths of a minute in length, had to be determined. As a result, however, of this standardizing of method, and also in a measure through the reducing of the tasks to a uniformity in the amount of labor required, the output was more than doubled, the machine costs reduced nearly 50 per cent, the labor costs reduced 25 per cent, while at the same time the wages paid showed an average increase of 33 per cent.

Essentials of System Illustrated by the Original Development of Scientific Management

As a further illustration of the essentials of system in carrying out standard methods, and as an illustration of the standards that may be developed in the system itself, we may consider how scientific management came into being.

It was some time in the eighties that Mr. Taylor found at the Midvale Steel Works, when he became foreman in the shop, that the method of setting piece rates engendered constant friction because, on the one hand, of the lack of uniformity in the rates, the cutting of rates, the soldiering of the men, and, on the other hand, because of the drive, drive, drive method by the bosses. To get over this inequality of rate setting, Taylor developed the system of elementary unit times which is described in his early paper, "A Piece Rate System."

When I first knew Mr. Taylor, about 1890, his chief thought in management, that is as applied to the handling of the work, had to do with the setting of piece rates. However, as he applied these rates, he found necessary three things:

(1) Control of materials.
(2) Control of conditions.
(3) Control of men.

For the control of materials, he developed the stores system, the balance of stores, standards of materials, routing of materials. For controlling conditions, he developed standard machines, standard tools, standard implements, slide rules, high speed steel. For the control of men, he developed routing, with its route sheets, bulletin boards, time cards, etc., instructions (requiring time study and analysis), disciplinarian and cost keeping system.

He found that, while little organization and system are necessary if the work is laid out hit-or-miss, if piece rates are set by guess, and quality of product adjusted only for the customer who kicks; just as soon as we get down to an accurate basis for doing things, just as soon as we develop exact standards—standards of materials, standards of methods, standards of time, standards of quality—the organization cannot be handled by any rule-of-thumb plan. It was necessary, in fact, in order to get refined results, to have a refined system. If we have standards, we must have control of those standards. You see the system was a means to the end of controlling the operation of standard methods.

Types of Management

In manufacturing, if we separate work into different types, we are apt to classify them on the basis of the material or of the product. *The broader plan—the plan in accord with modern principles of management—is to consider in the same type those in which the fundamental principles of treatment as outlined above are alike.*

Every plant presents the necessity for all the principles I have indicated, but the principles vary as to relative prominence in different plants. Considered from the point of view of method of attack and manner of treatment, industrial plants may be considered in three groups in which variously predominate:

(1) Scientific research, required for a plant where the production is handled as a whole by a continuous flow, as in a paper mill or in a pulp mill, or a cement mill, and where the principal study must be devoted to standardization of methods and improvement in quality.

(2) Planning and routing, required as the first essential where, as in a printing shop or a shop manufacturing miscellaneous but standard products with independent machines, these also involving much detail because of small orders or numerous parts.

(3) Analysis and detail instruction required as the chief essential, such as in a machine shop, along with complex planning and routing.

To illustrate what I mean by this grouping into types, I will take as an example two manufactories in which at first thought the industrial conditions are absolutely different, with no similar problems. At first thought, we would say that a plant making Portland cement is of a type as different as possible from a mill making paper. On the contrary (and in selecting these two examples, I am taking two processes which I know a little about) the two are essentially alike in type of management. I mean by this that the character of the problems involved when viewed from the standpoint of the scientific method, is the same, and similar principles of operation are required. In making this satement, I understand fully that the experience of a paper mill superintendent does not fit him for managing a cement mill. A cement mill manager, on the other hand, would be at sea in a paper mill. But let us consider the fundamental principles for a moment. In the paper mill, there are two chief raw materials, rags and pulp; in the cement mill there are two chief raw materials, one consisting essentially of limestone, and another consisting essentially of clay, or aluminous rock. In both cases, after certain preliminary treatment, the two raw materials go together, and then following a continuous process, not touched by hand until the product comes out in the one case at the end of the paper machine to the storehouse, and in the other case, from the grinders to the storage bins. The likeness is not merely superficial. In both products, quality is the chief aim and scientific research is necessary to determine the best way of attaining and retaining quality. In both, the character of the raw materials varies, and must be allowed for. In both the aim is to so mix these varying raw materials as to produce the product of required quality. In both the operation of the principal machines, in the one case, the beating engine, and in the other case, the kilns, are controlled, under ordinary methods of management, largely by judgment. In both processes, the manufacturer usually works backward, from the quality of the finished product to the raw material, and makes changes after having gotten the results from a previous run.

This is a broad way of looking at the subject, and I presume there are a certain number in the audience who have not yet been sufficiently inoculated with the germ of scientific management to appreciate the similarity in principle. Your cement man may think it absolutely absurd to believe he can obtain any points by attending the paper mill conference which is to follow. But if you consider the matter carefully, you will appreciate the fact that while the detailed nature of the tests and investigations to be made in two such diverse processes as these is entirely different, and while the routing in both cases is quite simple, in order to get the materials to their proper place, and while the analysis of the operations and the treatment of the machinery is different, we have in the two cases the same general type of management.

I wish I had the time at my disposal to indicate more in detail, the special features required for different classes of industry:

In the machine shop features requiring special attention and producing results are standardization of tools and machines, routing and instruction cards.

In the bank, the chief item may be the development of the personnel and the establishment of standard methods.

In the pulp mill it may be a matter of research to determine the raw material and the methods that will produce uniformity.

In the paper mill, it may be the standardization of the furnish and the handling of the beating engine.

In the textile mill, it may be the classification of the raw material and the routing to the different frames and in the spinning room the systematizing of the doffing.

In the shop manufacturing a standard product, it may be the investigation of methods to produce quantity and quality.

In the construction work, it may be the ordering of materials, the systematic distribution, the training to the right method.

In any development bear in mind that after all the most important consideration is the change in mental attitude not only of the workman but especially of the men in the management. Unless and until those in direct control of the plant or the business become thoroughly imbued with the scientific spirit, unless and until they are ready to accept the viewpoint that conclusions must not be reached by opinion but by duly recorded facts, unless and until they are ready to appreciate the necessity for separating the planning functions from the executive functions, there is little hope of progress.

Having made sure that the basic conditions, such as these, are favorable, the start in the introduction of scientific management must be determined not simply by the nature of the process but by the conditions in the particular plant. It may be that instead of starting at the point which is most rational from the standpoint of final judgment, the first efforts must be made in a department which is particularly congested or which especially needs help. One thing, however, must be borne in mind, that if a start is not made from the very bottom, the department tackled must be a unit in itself, and the materials must be going to this department in such a condition and in such a way as not to interfere with the proper organization under scientific management methods.

Just as soon as one comes into intimate contact with any plant, its individuality and the diversity of method required for operation are evident. We may refer briefly to two or three special processes. In the finishing room of a paper mill, for example, it is necessary first to establish a routing system, a control of all the materials and operations. Otherwise, it will be impossible to obtain proper distribution, it will be impossible to have the materials coming along in shape for time study or for standardization. With this in operation may come the opportunity for time study, standardization, and the other features of the installation, very important among these being the establishment of balance of stores.

In the paper making end of the paper mill, studies may be begun in connection with the standardization of the materials for the furnish of the beating engine, the determination of moisture in these materials, the investigations of the pulp and the rags. This naturally leads to the control of the beating engines and to the routing of the raw materials to the beater, and finally to the standardization of the paper itself.

In a textile mill the operations vary with the character of the product, whether it be cotton, woolen, silk, or jute. The raw materials usually require investigation and standardization before definite results can be obtained in the processes. In these investigations, as in all the scientific study, the tests must be laid out on paper in advance after thorough study of the whole plant and complete records made of the results as they are obtained. The scientific method based on comparison must always be adopted.

Construction work embraces many classes and types. In earthwork, the basic study is of the material itself; then, with the aid of time study, of the implements; and finally the arrangement of the gang and the routing of the work. In house construction the framing plans are an important feature, furnishing a guide for ordering materials, the methods for which have to be carefully studied, and proper plans laid out for gaging the times of delivery, etc. The establishment of a saw mill, the layout of the plant, may be an important feature in some cases, and always the preliminary work must be followed by the establishment of routing and time study.

It will be noted that all these various conditions come right down to the same fundamental principles of standardization of control.

Conclusion

Certain other features, which are distinctly features of scientific management, I have scarcely touched upon. These include stores classification, symbolization, task setting, and cost keeping. It is evident that these are of universal adaptation. Many of them are being introduced into plants which are not really operated under scientific management principles. On the other hand, it is difficult to conceive of a plant working under scientific management where some form of each of these features is not necessary.

The many details of system adopted first by Mr. Taylor have each one been worked out as a result of necessity, not as an end, but as a means for producing the end sought. The fundamentals, the standards, are what we must emphasize. Because a machine for turning out screws is a complicated affair, we do not discard it, we do not go back to the hand method; neither in management can we discard the tool of system even when it becomes complicated, provided it produces the result at which we are aiming.

In my discussion, I have tried to go as little as possible into the actual details of operation, and I have tried to emphasize:

(1) The fundamental nature of the principles of the science of management;

(2) The adaptability of these principles to all classes of work, and

(3) The necessity, in order to carry out the principles of standardization to develop a system of control to handle it; a system of control similar everywhere in character, yet varying in accordance with the particular type of industry, with the particular process, and in fact, since no two shops manufacturing the same product can be handled in identical fashion, the particular plant.

ON THE INDEX AS A FACTOR IN INDUSTRY[1]

By John H. Williams
New York City

Preface

The following paper was read before the Taylor Society at its Boston meeting in May, 1915. It occasioned considerable discussion, as a result of which it was arranged that I should confer at leisure with my principal critics, and that after revision and simplification the paper should be reprinted.

It has since developed that most of the criticism was of a certain idea expressed in the paper which is quite distinct from my advocacy of an index in industry or of the concrete rules cited for the making of such an index. I find it impracticable to do much to the paper as it was originally presented to elucidate this idea. The rules for making an index have been revised, and somewhat simplified and extended, and there are additional exhibits, but the body of the paper, beyond being simplified, remains very much as originally printed.

In reply to the request for more illustrations exemplifying this idea, I would say that an idea is not always fairly susceptible of illustration. Each time I try to use an illustration, I find the need for using a determination that is not, as yet, final, and which has been used in actual work only tentatively, to facilitate further steps. This is a situation which confronts any investigator who reaches the decision to share a generalization with his associates before being willing or ready perhaps to give to details the weight which publication would necessarily carry with it. Instead of changing the body of the original paper, I am writing this preface with the hope of amplifying, if not illustrating, the idea which has been the source of the criticism.

The essence of this idea is, that management is a branch of engineering, comparable to hydraulics, machine design and mining; and to be fairly entitled to recognition as a science, there must be some tangible means of expressing its product in *form*, as well as *result*. As I see it, the going business is the *result* in management engineering comparable to a generator of power as a result in mechanical engineering. By *form* I mean something comparable in vividness and concreteness to drawing in mechanical engineering.

In line with this idea, I have spent a great deal of time in an effort to build up a theory of visualizing management, which might be fairly compared to that underlying the use of drawing in mechanical engineering. The purpose of this preface is not to present the results of this effort but to urge the need for developing such means, and to emphasize the fact that we cannot hope or expect the present interest and enthusiasm in Scientific Management to crystallize into its public recognition *as a science* unless we not only *devise*, but also *standardize* and *use* such means. The importance of the index as a factor in such a means will become more and more apparent.

An architect, in planning a building, lays out his general plan, then sketches in and reconciles the various elements, as lighting, heating, ventilation, elevators, etc. Not until all of these and many others have been correlated and dovetailed, does he make his working drawing, much less start his building. Are the elements of management less conflicting? Yet how many of us proceed with our work in the same painstaking way? Until we do, we should not wonder that in spite of the results accomplished, there are people who refuse to accept management as a science.

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[1] Address presented at a meeting of the Society in Boston, May, 1915. *Copyright 1916, by John H. Williams.*

We may criticize the group designating themselves as efficiency engineers all we please, but so long as we continue to work very much as they do, with the distinction that we are in some cases better prepared, and more scientific in our methods, we have little reason to expect the public to distinguish between us. We must be willing to submit ourselves to the same arduous intensive work in laying out and visualizing our plans as the mechanical engineer does, if we wish to receive the same recognition.

Imagine creating an ocean liner, a modern hotel or office building, without drawings and specifications complete almost to the last detail prior to the beginning of construction. The image is identical with the one I get when I think of managing a great industry with no better preparation. Is the first problem greater than that of management? Almost the reverse is true. An investment is limited to the investment, whereas management, like the river, goes on forever. The very intangibleness of management, though evading, creates a greater need for concrete expression. It is only custom and our traditional habit of thinking that have prevented us from visualizing management. When Mr. Taylor conceived the idea that management was susceptible of analysis into its component parts, he shattered this tradition. The rest is a matter of application along lines already clearly indicated by Mr. Taylor.

I am aware that machines and buildings were constructed before the present stage in the development of specialization and of drawing, and that Scientific Management was developed and applied to some of our most intricate industries, with very little preparedness of the kind to which I refer. I believe, however, that the measure of difficulty that has been experienced in introducing Scientific Management is directly related to the lack of such preparedness.

The evolution and standardizing of a theory and means of visualizing management to the point of its acceptance by the public at large must needs be a matter of generations as it was with mechanical engineering, yet the Brittanica tells us that engineering was not recognized as a profession except in connection with war until the middle of the nineteenth century.

There is a natural antipathy to the arduous work of developing one's plans in full detail and recording them as a coordinate whole before beginning installation, especially where as with management there is a total lack of precedent in either method or usage. We must not forget, however, that this same antipathy existed in engineering, and that progress in this science has been made only so fast as this antipathy has been overcome. Only last year, Mr. Taylor, in a talk in Philadelphia, spoke of the reluctance and slowness with which engineers had come to make use of scientific information and means of visualizing which had long been available to them.

The human mind can deal with only a limited number of things and elements at one time. *The purpose of drawing, even more than to record progressive determinations, is to segregate problems or undertakings into groups small enough to be easily dealt with, yet so related as to indicate every requirement and limitation imposed by their relation.*

Drawing in engineering enables us to isolate and visualize any feature of a machine as separate and apart from every other feature, yet so related to the whole that if in designing or modifying any one feature we transgress any limitation imposed by any other, it will immediately become apparent. I have in mind a means for Scientific Management which is in every way comparable to this means in mechanical engineering.

On the Index as a Factor of Industry

The actual designations in the various exhibits are of no significance, being the result of the circumstance of the index from which they are taken.

Exhibits and examples have been confined to one index and principally to the root Cost, with the belief that symbols as applied to accounting will be easiest understood by the largest number of persons.

With the development of industry, both in vastness of individual organization and in complexity of product, the lack of adequate means of designation for recording information and methods has been increasingly apparent, and with the advent of Scientific Management, such a means has become a real necessity.

To meet this necessity an index constructed of symbols was devised, which serves not only as an index, but also to co-ordinate every material thing and function involved in the business concerned. This is known as the Mnemonic Index.

The idea of mnemonic symbolization goes back to the first efforts of man to record thought and events. These records were wholly pictorial, and both mnemonic and symbolic. From this simple beginning has gradually developed a method of literal designation through the use of our modern alphabet and numerals.

In the mnemonic index, we return to the early principle that the symbol shall suggest, rather than define. In place of pictures we use letters, which gain added significance according to their position in the symbol.

In "Shop Management," Mr. Taylor, in giving credit for suggestions of which he availed himself in building up his method of industrial control, (Par. 459) refers to:

> "The Mnemonic system of order numbers invented by Oberlin Smith and amplified by Henry R. Towne of Yale and Towne Co., Stamford, Conn."

Mr. Smith describes his own method in a paper entitled "Nomenclature of Machine Details," which he read before the *second* regular meeting of the American Society of Mechanical Engineers, in Altoona, Pa., in *1881*. The principal feature in this method, outside of the effort to make the symbol mnemonic, was the use of symbols in such a way as to suggest the grouping of the several machine parts.

Mr. Towne writing concerning his method, in a letter dated June 30, 1903, says:

> "——— the system of symbols for shop accounts which I devised many years ago, and which I still use.——— The essence of this consists in using letters in the same manner in which figures are used in the decimal system, *i. e.*, by making the value of the symbol depend on the 'column' or position it occupies relative to a base."

These methods have been further elaborated by Mr. Taylor and Mr. Barth and others of this group in the intervening years, so that there has been built up for the classification of the products of the industries into which Scientific Management has been introduced, a philosophy which is quite remarkable in its adaptability and significance.

In so-called tonnage work, where the product is prepared raw material, the symbolization of the product is simple, and without much industrial utility. But difficulties are apparent before one has gone very far in symbolizing the parts of an automobile and the materials and operations necessary to produce them, or the parts of a ten inch disappearing gun carriage, such as is manufactured at the Watertown Arsenal, which may have over 4,000 parts, made from fifty different materials. In such work as this, very little in the way of Scientific Management could have been accomplished without a comprehensive system of symbols.

The principle of symbolization is familiar in chemistry, and parallels its use in industry in three important points:

1. Symbols are used for brevity and convenience in writ-

ing, as the single letter H, instead of the eight letters required to write hydrogen.

2. As far as possible, chemists make their symbols mnemonic. Having used P for phosphorus, they use K for potassium, taking the initial of the Arabic name of potash, "Kali." In this respect, industry has an advantage, for in chemisty, there can be only one name for the element to be symbolized, while in industry there are an infinite number of synonyms and alternatives for almost anything you wish to designate.

3. Chemists combine symbols to indicate combinations; they write H_2SO_4 to express the action of sulphuric acid in a reaction and thus are saved the awkwardness of saying "two parts of hydrogen, one part of sulphur and four parts of oxygen."

The natural antagonism to the adoption of a new langauge, so to speak, occasions some difficulty in introducing the Mnemonic Index into general use in an establishment, but where the symbols are truly mnemonic, and are so constructed that they classify as well as designate, they are soon found to be a more simple and natural form of expression for managerial purpose than words.

The idea of a comprehensive classification and a complete index was inherent in Mr. Taylor's conception of industrial control. He has always held that every industry could be reduced to a definite number of functions and things. Over twenty years ago he had worked out a classification and a mnemonic system of symbols for stores, tools, products and charges.

With the growing mass of material gathered by Mr. Taylor and his associates, the necessity for classifying and symbolizing instructions became apparent, and several definite and fairly successful efforts were made to bring together all of the instructions of a business into one co-ordinate whole. The standing order files of the American Society of Mechanical Engineers, and of the Plimpton Press at Norwood, and the Code Book of Day and Zimmerman, Philadelphia, are the best examples of such indexing. The dates of these range from 1908 to 1911.

Although there has been a vast amount of time spent in making mnemonic indexes, I have not been able to find that any rules for this work have as yet been compiled. When I started to make a mnemonic index recently, I found it necessary to formulate rules for my own guidance. The purpose of this paper is to present the conclusions resulting from this work, with the hope that, whether or not you agree with them, they may provoke a discussion which will lead to further developments of what I believe to be the next logical step in the development of Scientific Management.

That I may be fully understood, I should explain that the work from which my conclusions are drawn was done in connection with the intended introduction of Scientific Management into several concerns in the same industry at the same time, with a view to eventually having an unlimited number of concerns in the same industry operating under the same methods and instructions.

My index is made not alone to index and designate stores, functions, products, etc., but also to serve as one element in a medium through which I might visualize and perfect my plans of management.

I have in mind an ideal for Scientific Management, of devising a means for working out and visualizing management which shall be as separate and apart from actual management, as the working out and visualizing of a machine is separate and apart from its construction.

I believe the Mnemonic Index is the first step to this means, and as far as possible, I have sought to make it applicable, even where its use has not been fully developed.

It has not been many years since practically all experimenting was done by empirical test—actual practice. Since then, we have learned to experiment on a drawing board, and so to eliminate not only the excessive cost of the other method but also its demoralizing effect. To a large extent, Scientific Management has been developed through the old method, and must continue to develop in this way until we devise some adequate means of expressing management on paper—until we get some visualizing means comparable to chemists' symbols, engineers' drawings, or musicians' notes. Everyone who has tried to express management in words alone realizes this.

There has probably been more waste in management than in any other form of human endeavor. Until recently the quality which makes successful managers has been considered as intangible a thing as personality. The familiar phrase "a born manager" illustrates this.

In few other fields has there been so much transient achievement. Vast businesses and enterprises have risen within one generation, only to fall within the next, chiefly because the principles which underlay their success could not be visualized and handed on, so as to be maintained, and yet at the same time modified to meet changing conditions.

This has to some extent been overcome in our large organizations, partly because habits established among larger groups are more permanent, and partly because with the subdivision of management into small units, only one unit at a time is jeopardized by the death or displacement of a single man.

A new management taking hold of a business is in much the same position as an engineer would be if he took over the direction of a complex machine without any drawings, and was dependent for all knowledge concerning it upon the circumstantial information furnished by employees.

As an objective toward which to work, I have assumed that:

A Mnemonic Index should indicate the subdivision of accounts, for both accounting and statistical work, and it should co-ordinate every material thing and every function within the business concerned.

It should serve as an Accounting Classification, and as an Index for the main subdivision of files. It should also designate all equipment and materials, down to the smallest tool and most insignificant article of stores, and all products and functions with which the business is concerned.

It should be easy of reference, and the symbols should be strongly suggestive, easily remembered, and susceptible to use as shorthand in writing instructions.

DEFINITIONS

One or more letters symbolizing words are termed a Symbol:

FCM Symbolizing the Function of Make-ready in the Cylinder printing division.

CAD Symbolizing an item of Cost Apportioned to a given product and representing a Direct (special) purchase.

Each letter in a symbol, and the words for which it stands, are termed a Designation:

F—Function, M—Make ready, C—Cylinder Printing Division in the symbol FCM.

C—Cost, A—Apportioned, D—Direct Purchase in the symbol CAD.

The first designation in a symbol is termed the Root Designation:

F—Function, in the symbol FCM.

C—Cost, in the symbol CAD.

The root designation in a symbol indicates the character of the symbol:
F—Function indicates the character of the symbol FCM.
C—Cost indicates the character of the symbol CAD.

All the rest of the designations in a symbol qualify the character of the symbol:
C—Cylinder Printing, and M—Make-ready, qualify the Function in the symbol FCM.
A—Apportioned, and D—Direct Purchase, qualify the item of Cost in the symbol CAD.

Turning first to physical characteristics, I suggest that a ring binder be used during the period of making, while the changes will be frequent. I also suggest using sheets of good strong bond paper, 20 pounds to folio, 8½ x 11, printed and punched as shown in exhibit A.

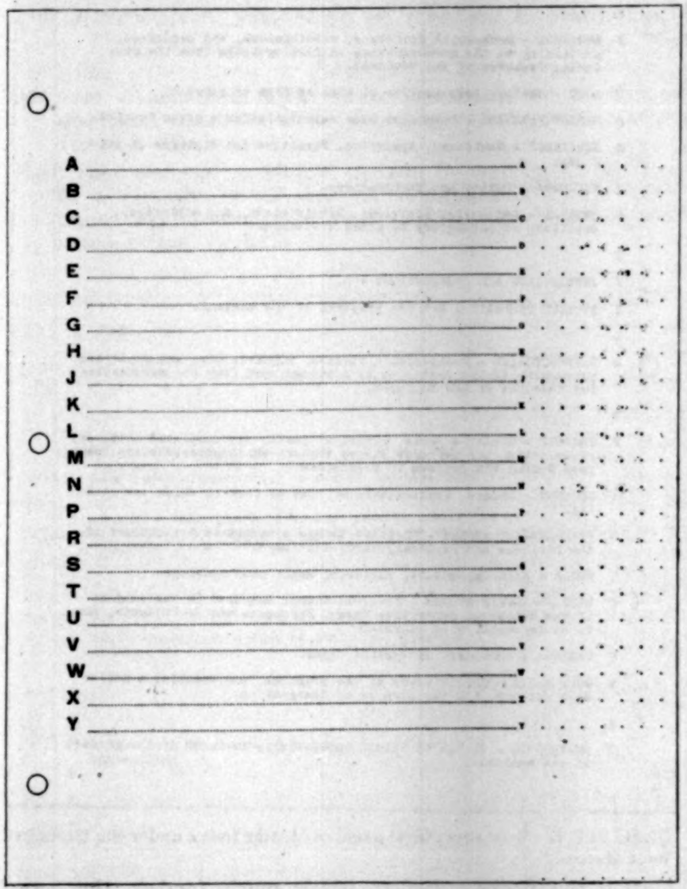

EXHIBIT A — Sheet used in laying out and perfecting the Master Index. The same sheet without the alphabet and lines to the left is used for final draft. See Exhibits B, E and F.

By writing the index letter of each sheet in the columns to the right of the sheet in the place corresponding to its place in the symbol, and cutting away the sheet beyond this letter, the sheets when put together will automatically index themselves. See Exhibits E and F.

Indexes for working purposes are best made in the form of Exhibits G and H.

It is the general practice to divide the alphabet into three groups, omitting I, O, and Q (exhibit C):
A to E to represent Expense Symbols.
G to W to represent Product Symbols.
X to Z to represent Construction Symbols.

A sub-index representing every desired qualification of each designation within these groups is then developed. The Expense Symbols are constructed so that they indicate the method of accounting, and the Product Symbols an analysis of production. By this method of limiting the number of roots so that they may be indicated by the group to which the symbol belongs, and to some extent depending upon the use of the symbol for some part of its meaning, there is a saving of one letter in some of the symbols.

The best results, however, are obtained through the use of the entire alphabet, without regard to groups, to designate every root under which there may be occasion to use symbols—the confining of the symbols developed from each root to the qualifications of the root proper—and the use of these symbols in combination (exhibit D).

This gives a series of small indexes, together constituting a master index from which separate working codes for use of departments and individuals are made. By keeping the symbols short and using them in combination, the least diversity and the greatest uniformity in the meaning of letters is accomplished, while it in no way lessens the fixity of the working codes. It offers in addition a scope of designation, flexibility, adaptability, and utility not otherwise obtained.

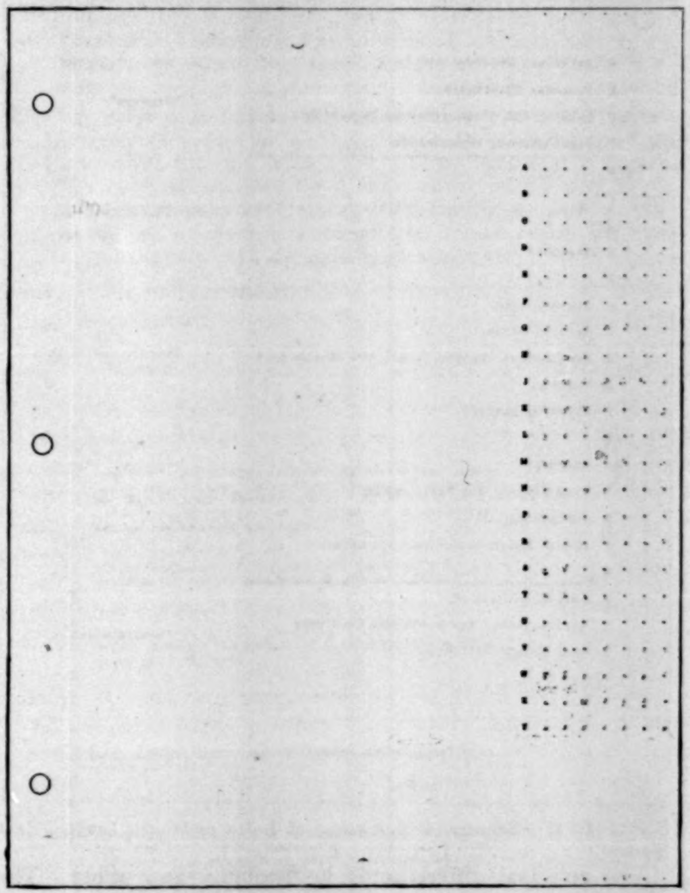

EXHIBIT B—Sheet used for final typewriter copy of Master Index. See Exhibit E and F.

For mere designation, there is very little need for using symbols in combination, but when we come to the use of symbols in writing instructions their utility is such as to create a real necessity for combining them, in which case they should be separated by spaces, as words are.

There is no apparent difference in the symbols as they appear in the working codes under the two methods, though the difference in the master index itself is very great. The accompanying illustrations, representing the first sheet of indexes under each method for the same industry will best illustrate this difference (exhibits* C and D). In referring to these methods I shall hereafter speak of them as the "limited" and "unlimited" root methods.

No claim is made for the particular root letters or designations used in any of the accompanying exhibits, except with reference to the problem before me. These will necessarily be different to some extent in every industry. They may differ even within the same industry.

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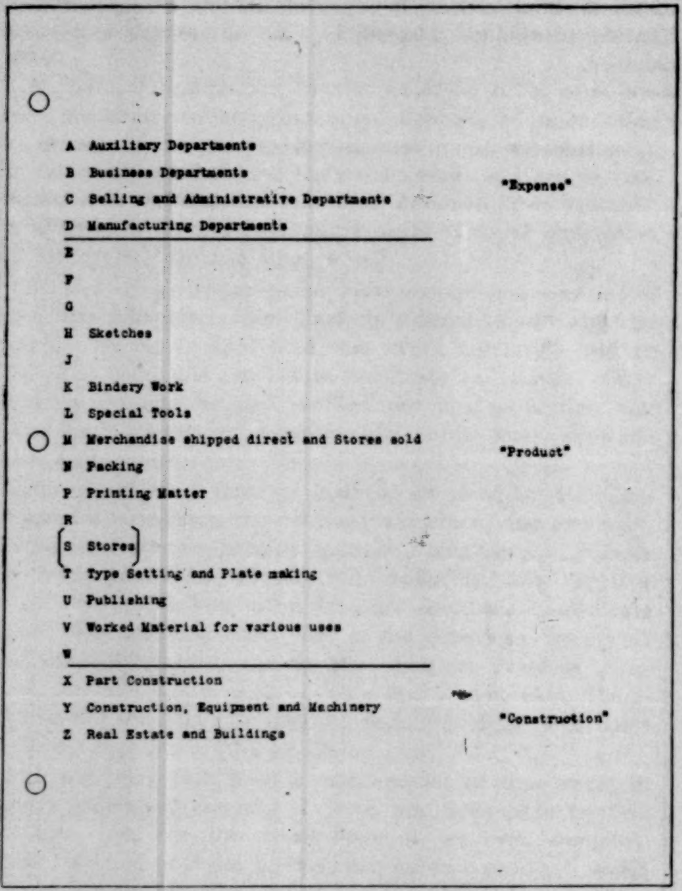
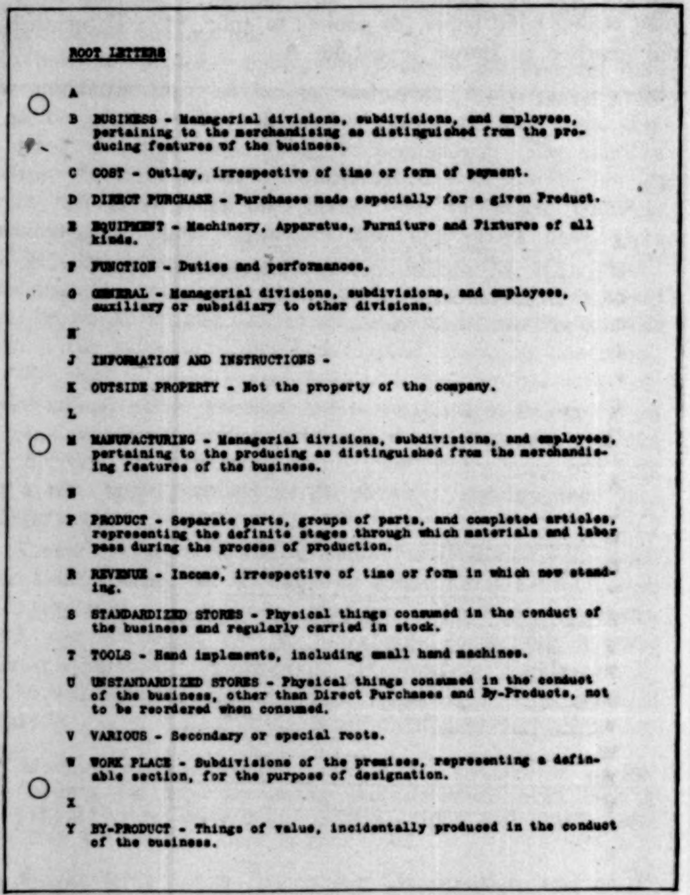
* The absence of definitions in Exhibit C has no significance other than that the index of which this page is a copy did not happen to contain them. They are given in exhibit F to illustrate certain features which will be dealt with presently.

The rules here given are compiled especially for a master index, made under the unlimited root method, but they are, with few exceptions, equally applicable to either method, or both. Before giving these rules, I wish to emphasize the exact relation of the two methods, and make it clear that the acceptance of the unlimited root method does not conflict with the principle involved in the limited root method.



A	Auxiliary Departments	
B	Business Departments	"Expense"
C	Selling and Administrative Departments	
D	Manufacturing Departments	
E		
F		
G		
H	Sketches	
J		
K	Bindery Work	
L	Special Tools	
M	Merchandise shipped direct and Stores sold	"Product"
N	Packing	
P	Printing Matter	
R		
S	Stores	
T	Type Setting and Plate making	
U	Publishing	
V	Worked Material for various uses	
W		
X	Part Construction	
Y	Construction, Equipment and Machinery	"Construction"
Z	Real Estate and Buildings	

EXHIBIT C — Root sheet (first page) of Index under the Limited Root Method.



ROOT LETTERS

A

B BUSINESS - Managerial divisions, subdivisions, and employees, pertaining to the merchandising as distinguished from the producing features of the business.

C COST - Outlay, irrespective of time or form of payment.

D DIRECT PURCHASE - Purchases made especially for a given Product.

E EQUIPMENT - Machinery, Apparatus, Furniture and Fixtures of all kinds.

F FUNCTION - Duties and performances.

G GENERAL - Managerial divisions, subdivisions, and employees, auxiliary or subsidiary to other divisions.

H

J INFORMATION AND INSTRUCTIONS -

K OUTSIDE PROPERTY - Not the property of the company.

L

M MANUFACTURING - Managerial divisions, subdivisions, and employees, pertaining to the producing as distinguished from the merchandising features of the business.

N

P PRODUCT - Separate parts, groups of parts, and completed articles, representing the definite stages through which materials and labor pass during the process of production.

R REVENUE - Income, irrespective of time or form in which now standing.

S STANDARDIZED STORES - Physical things consumed in the conduct of the business and regularly carried in stock.

T TOOLS - Hand implements, including small hand machines.

U UNSTANDARDIZED STORES - Physical things consumed in the conduct of the business, other than Direct Purchases and By-Products, not to be reordered when consumed.

V VARIOUS - Secondary or special roots.

W WORK PLACE - Subdivisions of the premises, representing a definable section, for the purpose of designation.

X

Y BY-PRODUCT - Things of value, incidentally produced in the conduct of the business.

EXHIBIT D—Root sheet (first page) of Master Index under the Unlimited Root Method.

The principal difference is in flexibility and utility. The limited root index is like an arbitrary code, whereas the unlimited root index is like an alphabet or vocabulary, from which—through using the symbols in combination—any number of codes may be written.

In the limited root method the real root is largely dependent upon the way in which the *symbol is* used unless we limit *their* use to the three roots expressed by the group Expense, Product, and Construction, to which they belong.

In the unlimited root method, each symbol is complete within itself, and is no more affected by the way in which it is used, or by combination with other symbols than are words.

The three fundamental principles sought after in working out these rules have been—brevity, standardization of terms, and sequence in relationship. The facility of symbols in expressing these fundamentals to which words and phrases are but clumsily adapted soon recommends them, even though the principle is not consciously understood; and has the effect of making the symbols apt and easy of use.

Words in language and their relationship—or lack of it, are the product of chance influences, such as the pursuits and temperament of the primitive people who originated them, the influence of earlier and contemporary languages, etc. The sequence of designations in symbols, on the contrary, is built up in a direct causal relationship, the subordinate growing out of the more basic terms, as the leaves of a tree grow out of the twigs, the twigs out of the branches, and the branches out of the parent limb.

Coming to the actual construction of the symbols, the method of accounting should first be determined upon, including the sub-division of accounts, not only for the general ledger, but for statistics as well, and also the method of closing the books. Before going much farther, the actual accounting symbols should be completed and thoroughly tested.

The tying-in of the accounting methods with the index is an essential of a proper index for an industry. The selection of the root letters is materially affected by the method of accounting, and every accounting symbol should not only designate, but should at the same time be a derivative of the accounting significance of the item represented by the symbol.

The sub-division of accounts is indicated in the symbols by the order in which the letters occur, reading always from the root toward the end of the symbol. The closing of accounts may be indicated in reverse order by reading the symbol backwards.

The master index should be fairly well developed as a whole and laid out in pencil, and finally revised only as the actual plan of management is determined upon and as Standing Instructions are written.

If the index is not fairly well developed as a whole, prior to the full development of any one root, it is almost inevitable that it will be unbalanced. On the other hand, it is impossible to perfect it beyond the accounting system, except in piecemeal as investigation and classification go forward.

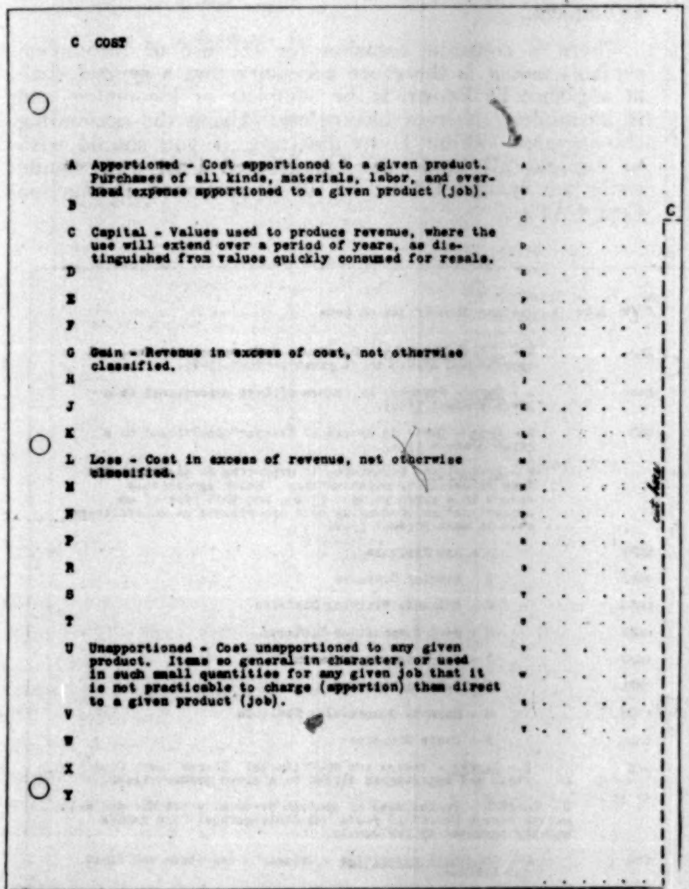
We should bear constantly in mind the fact that the majority of persons who will be called upon to use an index have not trained minds, nor a knowledge of the business, nor an understanding of the principles on which the index is constructed, to aid them in reading the symbols. No pains should be spared to make the index absolutely mnemonic. Fine distinctions in the meaning of words should always be sacrificed to the selection of words which may be literally symbolized.

In the foregoing page of Root Letters under the unlimited root method (exhibit D), containing seventeen designations for twenty-two letters, there is only one designation which is not entirely mnemonic; as J and K, used instead of I and O respectively, may fairly be regarded as mnemonic.

RULES

All root designations with definitions should be written on one sheet constituting the first page of the master index (exhibit D).

Each root designation should in turn be written at the head of a separate sheet, and the designations (with definitions) representing the first qualifications of the root, listed below (exhibit E).



C COST

A Apportioned - Cost apportioned to a given product. Purchases of all kinds, materials, labor, and overhead expense apportioned to a given product (job).
B
C Capital - Values used to produce revenue, where the use will extend over a period of years, as distinguished from values quickly consumed for resale.
D
E
F
G Gain - Revenue in excess of cost, not otherwise classified.
H
J
K
L Loss - Cost in excess of revenue, not otherwise classified.
M
N
P
R
S
T
U Unapportioned - Cost unapportioned to any given product. Items so general in character, or used in such small quantities for any given job that it is not practicable to charge (apportion) them direct to a given product (job).
V
W
X
Y

C

cut here

EXHIBIT E — A second page under the Unlimited Root Method.

Also illustrates the locating of index letter and cutting of sheet for automatic indexing.

Each succeeding qualifying designation, preceded by preceding designation, should in turn be written at the head of a separate sheet, and further qualifications made in like manner (exhibit F).

I, O and Z are not used because they are easily confused with the numerals 1, 0, and 2.

Q is not used because it is difficult to write accurately.

Words beginning with I and O should be used as designations as little as possible, and when used, should be placed opposite J and K respectively. This is because J and K are seldom used, and therefore, confusion through double meaning will be infrequent.

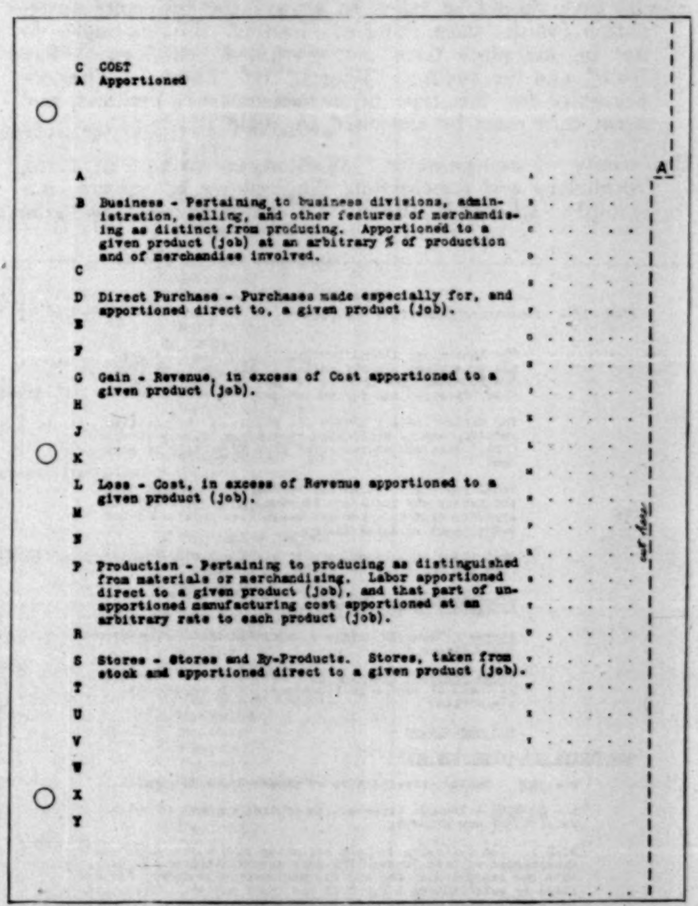
Words beginning with Q and Z may easily be omitted as designations, and therefore no provision need be made for them.

Numerals may be used as designations. They are often desirable and sometimes necessary where there are more qualifications than there are letters. They should be put before the designation which they qualify instead of after it as with letters.

Numerals may be used at the end of a symbol only to indicate sequence in the thing symbolized, as order or lot number, etc.

Every designation should, as far as possible, begin with the letter which is to represent it in the index. To accomplish this, all qualifying designations, at any given stage in the construction of a symbol, should first be written opposite the letter with which the designation begins. This will frequently cause several designations to be placed opposite the same letter, at this preliminary stage.

Dealing with the letters opposite which there are several designations, one at a time, look over the designations, and select the one least used. Then consult a thesaurus (an essential in making a mnemonic index) and see if you cannot substitute some word beginning with a letter which has no designation opposite it, and which for symbolic purposes will be equally descriptive.



C COST
A Apportioned

A
B Business - Pertaining to business divisions, administration, selling, and other features of merchandising as distinct from producing. Apportioned to a given product (job) at an arbitrary % of production and of merchandise involved.
C
D Direct Purchase - Purchases made especially for, and apportioned direct to, a given product (job).
E
F
G Gain - Revenue, in excess of Cost apportioned to a given product (job).
H
J
K
L Loss - Cost, in excess of Revenue apportioned to a given product (job).
M
N
P Production - Pertaining to producing as distinguished from materials or merchandising. Labor apportioned direct to a given product (job), and that part of unapportioned manufacturing cost apportioned at an arbitrary rate to each product (job).
R
S Stores - Stores and By-Products. Stores, taken from stock and apportioned direct to a given product (job).
T
U
V
W
X
Y

A

cut here

EXHIBIT F — A third page under the Unlimited Root Method.

Also illustrates the locating of index letter and cutting of sheet for automatic indexing.

You will be surprised at the frequency with which you find a better word. Even if the word is not as good, it is more important that the designation should be mnemonic than literal, so long as it is symbolic of the definition of the designation. Repeat this process until there is not more than one designation apportioned to any one letter.

When you use a letter to indicate a word beginning with some other letter than the one opposite which it is placed, and this process is repeated more or less throughout the hundreds or even thousands of uses of an alphabet within an index, there is literally no guide for the memory. Whereas, in substitution of one word or phrase for another, since you adopt and use the accepted word and phrase only, it soon becomes fixed in the memory, and the former word or phrase disappears as completely as though it had never been known.

When you have gone the limit under the foregoing instructions, and there still remains a letter with more than one designation opposite it, select the designation most used, and put it opposite the second letter in the designation. If this is in use, then the third, and so on down, always, however, giving preference to a letter carrying the dominant sound of the designation, as the letter V is dominant in service.

The natural tendency is to leave the designation most used opposite the letter which characterizes the designation. The reason for doing the reverse is that it is easier to remember an inconsistency that is frequently used than one seldom used. When placing designations opposite letters other than the one characterizing it, always give preference to unused letters, so that those most generally applicable will be left available.

Every designation should describe rather than arbitrarily designate the thing symbolized, just as the words railroad, typewriter, and aeroplane suggest the nature of the objects that they designate.

Special care should be taken to always use the same designation for the same thing or meaning. For example, do not in one place term money paid to employees "Pay Roll," and in another "Wages," or "Labor." The opportunity for this type of inconsistency is limitless, and great care must be exercised to avoid it.

Uniformity is indispensable. Without uniformity in form, vocabulary and punctuation, the memory has to act consciously, where it should act automatically, and the use of the index becomes laborious. When the mental photographs of the index are uniform, it becomes as natural to write and read symbols as words.

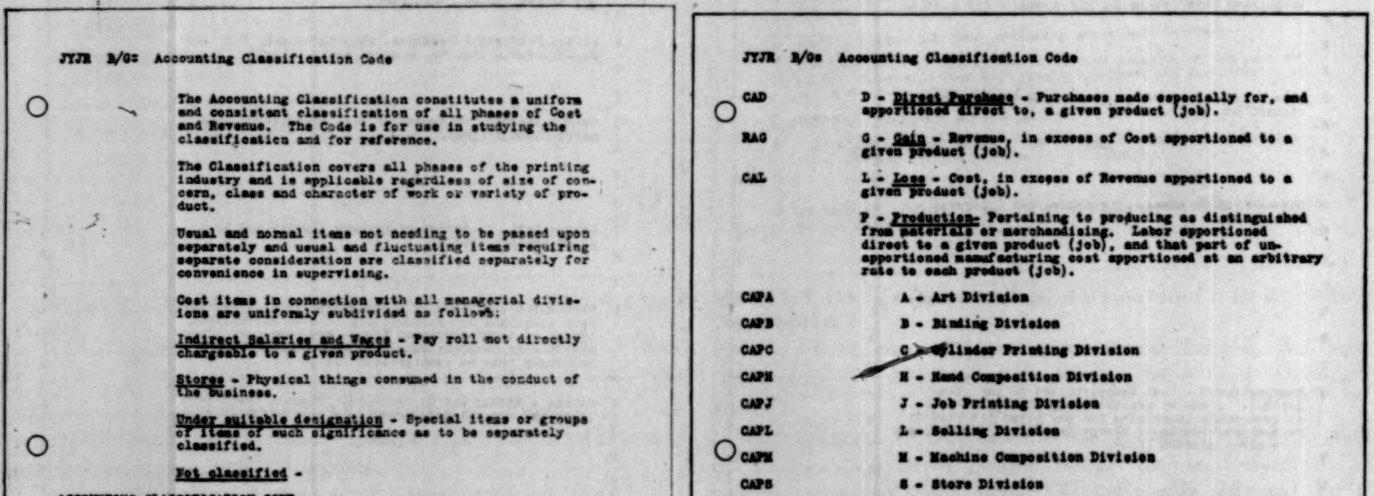
Designations constantly recurring throughout all symbols, such as Miscellaneous, meaning not otherwise classified, should be placed opposite letters which have the least mnemonic use. I suggest X, and the use of the designation "Not otherwise classified," as being more definite than "Miscellaneous."

When the number of qualifications is greater than the available letters, and numerals are not desirable, I suggest the use of the designation "Various" opposite V, as indicating the reopening of the alphabet. The V in this case is used as a silent letter in the symbol, and the designation qualifying it should have some special characteristic. As, for example, in a Stores symbol it is well to put all the given names—that is, manufacturing names—after the designation V.

In a designation of two or more words, as Direct Purchases, the dominant or distinguishing word of the designation (Direct) is the word to be considered in determining the letter opposite which it shall be placed, as it is the one which will most naturally occur to the memory.

In using incomplete symbols always put an = mark to indicate missing letter or letters. In this way a symbol without an equal mark indicates a complete symbol, whereas, on the other hand where there is an = it not only indicates an incomplete symbol, but wherein it is incomplete.

There is constant occasion for the use of incomplete symbols and it is therefore necessary that a symbol shall at a glance be known to be complete or incomplete and if incomplete wherein incomplete. Using the accounting classification exhibit H to illustrate, if you should wish to express all kinds of Apportioned Cost you should write the symbol CA=; on all Apportioned Production Cost CAP=.



JYJR B/G= Accounting Classification Code

The Accounting Classification constitutes a uniform and consistent classification of all phases of Cost and Revenue. The Code is for use in studying the classification and for reference.

The Classification covers all phases of the printing industry and is applicable regardless of size of concern, class and character of work or variety of product.

Usual and normal items not needing to be passed upon separately and usual and fluctuating items requiring separate consideration are classified separately for convenience in supervising.

Cost items in connection with all managerial divisions are uniformly subdivided as follows:

Indirect Salaries and Wages - Pay roll not directly chargeable to a given product.

Stores - Physical things consumed in the conduct of the business.

Under suitable designation - Special items or groups of items of such significance as to be separately classified.

Not classified -

ACCOUNTING CLASSIFICATION CODE

C - COST - Outlay, irrespective of time or form of payment.

R - REVENUE - Income, irrespective of time or form in which received or now standing.

NOTE I. The following symbols beginning with C represent the subdivision of Cost Items. The same subdivisions and symbols, with the exception of CAL and CL, are used to represent Revenue Items by substituting R for C as the first letter. Corresponding modification must be made in definitions.

NOTE II. Wherever a letter is used in several symbols, representing the same designation, the definition is given only once,- in the case of its first use, except where necessary for clearness.

A - APPORTIONED - Cost apportioned to a given product. Purchases of all kinds, materials, labor, and overhead expense apportioned to a given product (job).

CAB B - Business - Pertaining to business divisions, administration, selling, and other features of merchandising as distinct from producing. Apportioned to a given product (job) at an arbitrary % of production and of merchandise involved.

JYJR B/G= Accounting Classification Code

CAD D - Direct Purchase - Purchases made especially for, and apportioned direct to, a given product (job).

RAG G - Gain - Revenue, in excess of Cost apportioned to a given product (job).

CAL L - Loss - Cost, in excess of Revenue apportioned to a given product (job).

P - Production- Pertaining to producing as distinguished from materials or merchandising. Labor apportioned direct to a given product (job), and that part of unapportioned manufacturing cost apportioned at an arbitrary rate to each product (job).

CAPA A - Art Division

CAPB B - Binding Division

CAPC C - Cylinder Printing Division

CAPH H - Hand Composition Division

CAPJ J - Job Printing Division

CAPL L - Selling Division

CAPM M - Machine Composition Division

CAPS S - Store Division

CAS S - Stores - Stores and By-Products. Stores taken from stock and apportioned direct to a given product (job).

C - CAPITAL - Values used to produce revenue, where the use will extend over a period of years, as distinguished from values quickly consumed or for resale.

CCC C - Company's Securities - Company's own stock and fixed indebtedness.

E - Equipment - Machinery, apparatus, furniture and fixtures of all kinds.

CCEA A - Art Division

CCEB B - Binding Division

CCEC C - Cylinder Printing Division

CCEF F - Furniture and Fixtures - Not classified as part of the equipment of any one division, and including all time-keeping and cost-finding equipment. Furniture regularly used in the different divisions is classified as of the division in which it is used.

H - Hand Composition Division

EXHIBIT G—Working Code. The various desks are supplied with separate Working Codes representing the roots which they may have occasion to use. These are used principally in introducing the Index and thereafter for reference.

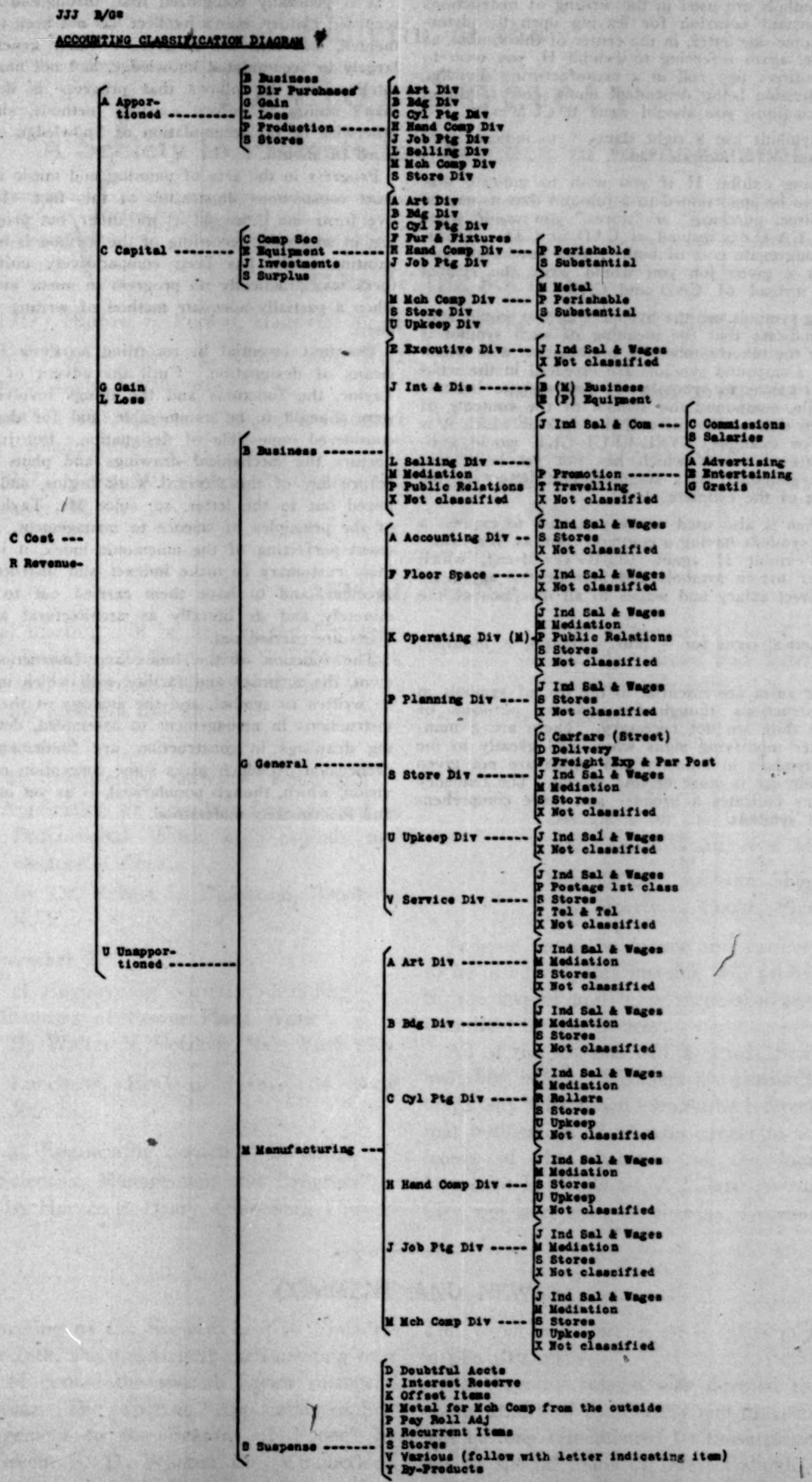


EXHIBIT II — Working Diagram. For quick reference in practical daily use.